UNIVERSITY OF GONDAR

COLLEGE OF MEDICINE AND HEALTH SCIENCE

INSITUTE OF PUBLIC HEALTH

DETERMINANTS OF STUNTING AMONG UNDER-FIVE CHILDREN: EVIDENCE FROM THE 2011 ETHIOPIAN DEMOGRAPHIC AND HEALTH SURVEY

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Acronyms

CBN	Community Based Nutrition
CEA	Census Enumeration Area
CSA	Central Statistical Agency
DHS	Demographic and Health Survey
EDHS	Ethiopian Demographic and Health Survey
ENA	Emergency Nutrition Assessment
EOS	Enhanced Outreach Strategy
GDP	Growth Domestic Product
FMOH	Federal Ministry of Health
HAZ	Height-for-Age Z-score
HEP	Health Extension Programme
HCWs	Health Care Workers
HH	Household
ICF	Inner City Fund
Km	Kilometer
NNP	National Nutrition Programme
PI	Principal Investigator
SD	Standard Deviation
SNNP	Southern Nation and Nationality and People
SSA	Sub-Saharan Africa
USA	United States of America
WHO	World Health Organization

Table of Contents

Contents Pages

List of tables

Lists **Pages**

List of Figures

List of Figures **Pages**

Abstract

Background: - Childhood stunting is one of the most impediments to human development. The causes of stunting are numerous and ranging from immediate determinants such as poor diet and disease to the basic determinants like socio-economic and political conditions.

Objectives: - To identify determinants of stunting in children less than 5 years based on the 2011 EDHS data.

Methods: - Unmatched case control design was employed by using data of the 2011 EDHS. 4233 cases and 5655 controls identified by HAZ-score of EDHS 2011 were included in the study. Extraction and recoding of variables were performed and analysis using SPSS version 20 was done from March to June 2015.

Results: Children in the age group 24 to 35 months were at the highest risk of stunting (AOR=5.526 with 95%CI=2.172, 14.060) compared to the children less than six months. The other age groups 12-23, 36-47 and 48-59 were also significantly associated with stunting. Children with narrow (AOR=1.881, 95%CI=1.414, 2.503) and moderate preceding birth interval were (AOR=1.704, 95%CI=1.341, 2.164) times more likely to be stunted as compared to those with wide preceding birth interval. Anemia status (AOR=1.304, 95%CI=1.197, 1.420) and husband education (AOR=2.042, 95%CI=1.022, 4.080) were also associated with stunting. Households with two and more than three under five children (AOR=1.846 95%CI=1.393, 2.446) and (AOR=1.458, 95%CI=1.410, 1.864) times more at risk of being stunted than with single under five children respectively. The children from poorer households were (AOR=2.042, 95%CI=1.445, 2.885) times higher at risk of being stunted than those of the richest.

Conclusions and Recommendations: This study identified age of the child, anemia status of the child, preceding birth interval, paternal education and household wealth index as an independent determinants of stunting and efforts towards reducing stunting should consider these determinants.

Key words: Ethiopia, Stunting, Case Control, DHS

1. Introduction

1.1 Statement of the problem

Child malnutrition can manifest itself in several ways. It is most commonly assessed through measurement of child's height and weight, as well as through biochemical and clinical assessment (1).

Stunting, being too short for one's age, is defined as a height that is more than two standard deviations below the World Health Organization (WHO) child growth standards median. It is a largely irreversible outcome of inadequate nutrition and repeated bouts of infection (2, 3).

The causes of stunting are numerous and multifaceted. These causes are intertwined with each other and are hierarchically related. The most immediate determinants are poor diet and disease which are themselves caused by a set of underlying factors; household food security, maternal/child caring practices and access to health services and healthy environment. These underlying factors themselves are influenced by the basic factors (socio-economic and political conditions) (4, 5).

It has been revealed that household (socio-economic and demographic) factors such as household's poverty and income, residence, occupation, education, maternal age, family size and violence, overcrowding, lack of exposure to mass media, have influenced the occurrence of acute child under-nutrition. Concomitantly, some community factors including lack of maternal and child health services, adequate and safe water supply, and improved environmental sanitation play their role (6).

Moreover, maternal under-nutrition, narrow birth interval, child related factors such as child's sex, age, weight at birth , and hospitalization, lack or improper delivery services, and poor infant and young child feeding practices (IYCF) have been identified as proximate risk factors for child stunting (6-8).

Stunting negatively impacts work capacity and productivity, increases the risk of obesity and related non-communicable diseases, such as hypertension and diabetes, and poor delivery and birth outcomes in women who are stunted adults (9, 10). Stunting reduces lifetime earnings by 10% and GDP by 2–3% in low- and middle-income countries (10). Childhood stunting is one of the most impediments to human development, globally affecting approximately 162 million children under the age of five (2). But this burden is not evenly distributed around the world. Sub-Saharan Africa (SSA) and South Asia are the home to three fourths of the world's stunted children. In SSA, 40% of children under 5 years of age are stunted; in South Asia, 39% are stunted and Ethiopia is the seventh among the fourteen countries that are the home to 80% of the world's stunted children (1).

The poor nutritional status of children and women has been a serious problem in Ethiopia (8). Nationally, 40 percent of children under age five are stunted, and 19 percent of children are severely stunted (11).

Different studies showed that child under-nutrition is responsible for 54% of the deaths of children under five years of age (nearly 11 million children) globally (12) and for 51% of the deaths of Ethiopian children in the same age category (8, 13, 14).

Stunting of under 5 children has decreased from 58% to 40% in the past 15 years (11) though 40% is still high and needs further investigation to identify for its determinants.

Thus, in this study factors that have more contribution to this health adverse was determined using nationwide representative data.

1.2 Literature Review

1.2.1 Prevalence of Stunting

Stunting is defined by a height-for-age z-score (HAZ) below -2SD of the median height of WHO reference population (15). It is a well-established child-health indicator of chronic malnutrition which reliably gives a picture of the past nutritional history and the prevailing environmental and socioeconomic circumstances (16).

Globally, 161 million under-five year olds were stunted in 2013.The global trend in stunting prevalence and numbers affected is decreasing. Between 2000 and 2013 stunting prevalence declined from 33% to 25% and numbers declined from 199 million to 161 million and about half of all stunted children lived in Asia and over one third in Africa(17).

Ethiopia is among the 21 countries of the world where the prevalence of stunted children under age 5 is at least 40 per cent (1). Under-nutrition, particularly stunting has been a serious problem in Ethiopia for many years and 40 percent and 19 percent of children under age five are stunted and severely stunted respectively (8, 11).

1.2.2 Determinants of stunting

The set of determinants for malnutrition, specifically for stunting and wasting, is too complex. Inadequate and/or inappropriate dietary intake and infectious disease are the immediate causes while these in turn are related to a number of factors such as socio-economic and demographic, child health and care, maternal and environmental factors (18).

1.2.2.1 Child characteristics

As study conducted in Cambodia indicated, child stunting showed a statistically significant association with a child's sex and age. Males under five children are more vulnerable to stunting than those of female counterparts with AOR 1.1057 (1.0122–1.2078) and stunting increase by 1.0307 units with (1.0278–1.0336) 95%CI for a unit increase in month of the child (19). The further analysis of the 2008 Ghana DHS made known that there was a significant relationship between age of child and stunting as

children aged 36–47 months were 10.4 times more likely to be stunted compared to those aged less than six months(20). In similar ways, increased age of the child was statistically associated with stunting in children aged 0-59 months (AOR = 1.03, 95%CI: 1.02 - 1.04; p < 0.001) (21). Again odds of being stunted were higher in older age groups than the younger age group. It was 2.5, 3.5 and 4.5 times higher in 6-11 months, 12-23 months, and 24-36 months as compared to 0-5 months in the study done in rural India(22)

In the Study conducted in Borana, South Ethiopia, male children were 2.8 times (AOR=2.8, 95% CI: 1.5-5.3) more likely to be stunted compared with female children (23). The other study conducted in India revealed that boys were more stunted than girls (p<0.01) (24). Another supportive finding was also obtained from the study in Indonesia that girls aged 0-59 months had statistically significantly reduced odds of being stunted compared to boys aged 0-59 months (AOR = 0.72, 95% CI: 0.58 - 0.90; p = 0.005) (21).

From study done in West Gojam Zone, prolonging breastfeeding is associated with the risk of stunting. Children who had been breastfed for 12-24 months were 2.2 times more likely to be stunted than children who had been breastfed less than one year (16). From the same study, incidence of diarrhea was positively and significantly associated with stunting. Children experiencing diarrhea were 2.3 times more likely to be stunted compared to the reference category (16). Acute respiratory infection (defined as having symptoms of cough accompanied by short, rapid breathing which was chest related during 2 weeks preceding the survey), and any child with watery or blood and mucus stool in the 2 weeks preceding the survey was considered as having diarrhea were also the child level factors (25). Similar result was obtained from the study conducted in Bule Hora district, South Ethiopia(23)

In general, the prevalence of stunting in Ethiopia increases as the age of a child increases, with the highest prevalence of chronic malnutrition found in children age 24-35 months (52 percent) and lowest in children between age six and eight months (9 percent). With the exception of first births, there is an inverse relationship between the

length of the preceding birth interval and the proportion of children who are stunted. The longer the interval, the lower the proportion of children stunted(8).

Birth order was also the main determinant as the study conducted in Bangladesh confirmed. In this study, the prevalence of stunting is somewhat higher among children of fourth-order births or higher than other births (26).

Anemia status of the children was also identified as the determinants of stunting from the findings of Central India as children having anemia had 1.9 times higher odds of being stunted than children who were not anemic (22).

1.2.2.2 Parental characteristics

The results of further analysis on Nepal Demographic and Health Survey confirmed that the odds for severely stunted children aged 0–59 months for babies not currently being breastfed and children whose mothers could not read decreased significantly by 41% (adjusted OR = 0.49; CI: 0.34, 0.69; $p < 0.001$ for currently being breastfed children aged 0–59 months) and 51% (adjusted OR = 0.49; CI: 0.34, 0.69; $p < 0.001$ for children whose mothers could read)(25). In another study from India, children whose parents had education of 10 years or less had higher odds of being stunted/severely stunted than those children whose parents had education of more than 10 years. The relative odds of stunting was higher among children with illiterate father (OR=1.8) than that of illiterate mother (OR =1.2) though there was no significant association observed between mother's occupation and the children's stunting in this study (22).

The results show that children whose mothers' were aged 25–34 years were less likely to be stunted compared to those whose mothers were aged 15–24 years (20) which supported the findings that obtained that children of older mothers are more likely to suffer from growth-stunting than those whose mothers are in a younger age group (26).

Moreover, children aged 0–59 months perceived by their mothers to be large (adjusted OR = 0.47, 95%CI: 0.33,0.67; $p = 0.001$) were significantly less likely to be stunted than

children of the same group perceived to be small by their mothers at the time of delivery (25).

Another finding in Bangladesh supports mother's educational status is the most determinate factor on child nutritional status. It shows that the risk of having worse nutrition status was found highest for the children having mothers with no education (about 3.0 times) when compared with highly educated mothers' children (27).

Maternal occupation is also another factor as it was reported on study done in Gurage zone of SNNP indicated children whose mothers worked as merchants [AOR = 4.03, 95% CI: 1.60, 10.17] and farmers [AOR = 3.92, 95% CI: 1.89, 8.16] were more likely to be stunted than children whose mothers worked as house wives (28).

Another study in Nairobi indicated that mothers' marital status, parity, and place of delivery are independently associated to child stunting. The odds of stunting for children born to mothers who were never married are 56 % higher relative to those who are currently in union ($p<0.05$). Mother's parity was also marginally associated with stunting. The odds of stunting for children born to mothers who have two births, and three or more births are 31 % and 39 % higher compared to those that have one child respectively ($p<0.05$) (29). By the same study in Nairobi Kenya, the odds of stunting for a child born to a mother who gives birth in a traditional birth attendant facility or at home are 39 % higher compared to giving birth in a health facility ($P<0.05$).

1.2.2.3 Household characteristics

Study carried out in Uganda revealed that children of households belonging in the "poorest" quintile for the asset index compared to the "least poor" quintile are more stunted (OR 2.1, 95% CI 1.2–3.7) (30). There was also a significant relationship between household wealth and stunting among children. For instance, children belonging to richer households were 0.43 times less likely to experience stunting compared to the poorest ($p < .001$)(20). Multilevel Analysis in Nigeria indicated as each SD increase in the household wealth index and decreases the odds of being stunted by 16% (AOR 0.84; 95% CI 0.76–0.94) (31). There is also another similar findings in Indonesia that children aged 0-59 months from families in the least poor or middle

household wealth index categories had reduced odds of being stunted compared to those from the poorest families (21).

A significant relationship was observed between number of children and stunting among children. For instance, it was observed that children whose mothers had 5–8 children were more likely to be stunted compared to those whose mothers had 1–4 children (OR = 1.3, $p < 0.05$) (20).

Research conducted in India identified household toilet facility is a significant risk factors. According to this study, children residing in households without having toilet facility were 1.5 times more at risk of developing stunting as compared to children in households with toilet facility. Further, children in households with unsatisfactory practice of storing drinking water were 2.2 times more likely to have stunting than children living in households with satisfactory practice of drinking water storage (32).

1.2.2.4 Community characteristics

The result of the study in Ghana demographic and health survey/GDHS showed an apparent narrowing in the urban/rural underweight gap. In the analyses of underweight by rural/urban place of residence, the declining trends were significant for rural males ($F(1, 5376) = 24.22$, $p \leq .001$) and rural females ($F(1, 5376) = 14.22$, $p \leq .001$), while the declining trends for urban males and females were not significant (33). Region was significantly related to stunting in Ghana. Children from the Eastern Region were more likely to be stunted than children from the Western Region which is the reference group (OR = 1.7 at $p < 0.05$) (21).

The percentage of children stunted is higher in rural areas (42 percent) than in urban areas (27 percent). There is regional variation in the prevalence of stunting in children. Stunting levels are above the national average in Tigray and Affar (46 percent each), SNNP (44 percent) and Amhara (42 percent), and relatively low in Gambela and Addis Ababa (22 and 23 percent, respectively) (11).

1.2.3 Conceptual Frame Work of the Study

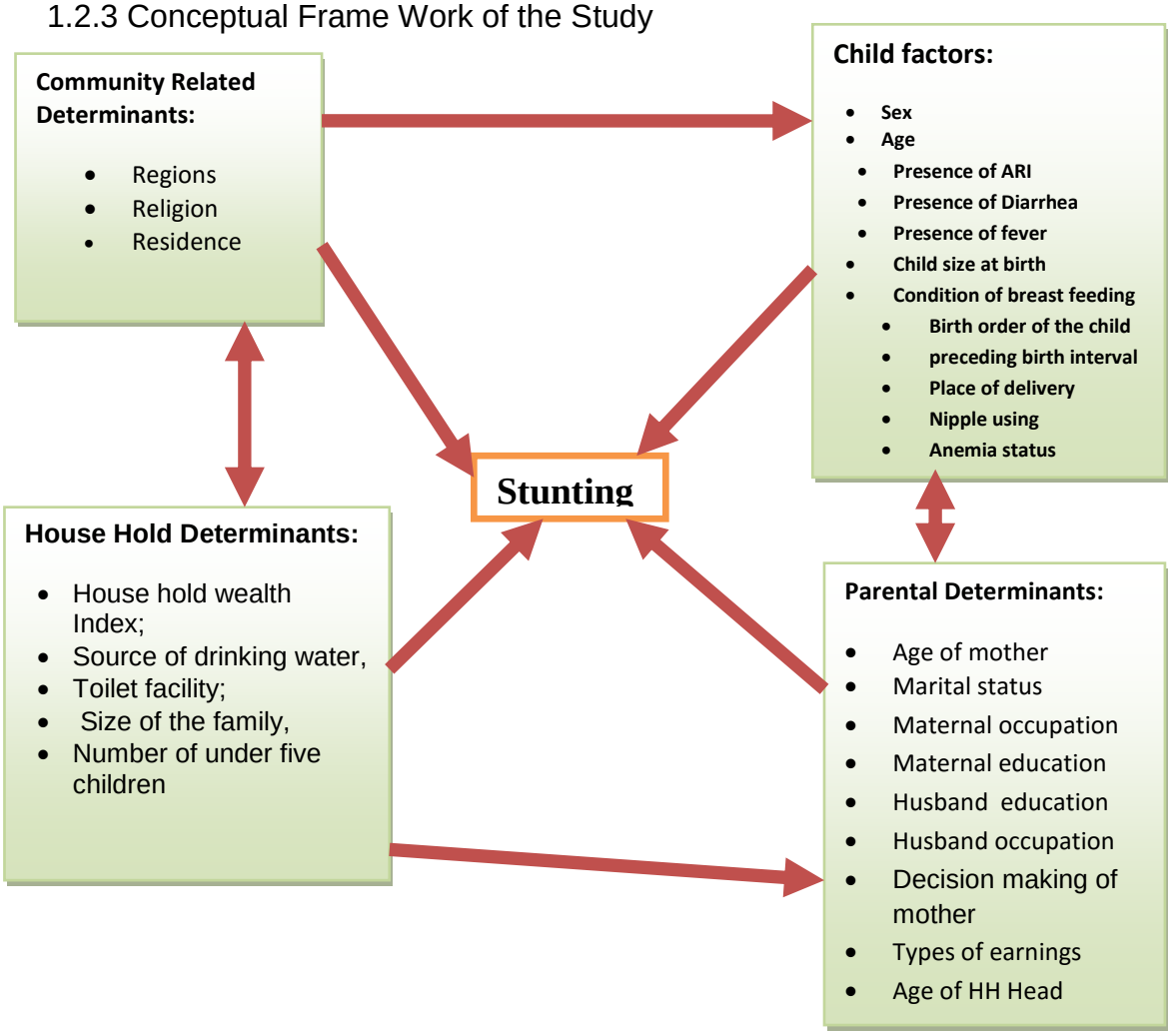

Figure 1: Conceptual framework of the study

(Source: Developed by principal Investigator by reviewing different literature)

1.3 Significance of the study

Malnutrition is the underlying cause of nearly half of all child deaths and the chronic malnutrition leads to stunting which is an irreversible condition that literally stunts the physical and cognitive growth of children, with lifelong consequences that affect everything from school performance to future earnings, hinders socio-economic development of a nations.

Reduction of malnutrition in general and stunting in particular has gained global recognition for sustainable development. Reduction of stunting by 40% in the number of children under-5 who are stunted by 2025 is one critical component of the Post-2015 Development Agenda (2).

The government of Ethiopia has already put in place programmes with set targets that directly and indirectly contribute to the reduction of under-nutrition through Enhanced Outreach Strategy/ EOS with Targeted Supplementary Food and Transitioning of EOS into the Health Extension Programme, Health Facility Nutrition Services, Community Based Nutrition (CBN), and Micronutrient Interventions and Essential Nutrition Actions. The target is to reduce the prevalence of stunting to 30% by 2015 though the discrepancy remains10% (11, 34).

In order to achieve the global stunting target for 2025, Ethiopia needs to assess the determinants of stunting at national level so that actions are tailored to address the problem.

Many previously conducted studies in Ethiopia have found factors that are associated with stunting at district, zonal or at some specific places. Limited studies were conducted at national level. Moreover, this study employs a case control design with large sample size in order to determine the significant determinants of stunting because it better detects the association than simple cross sectional studies with small sample size.

Therefore, this study aimed to identify determinants of stunting using the nationally representative data with large sample size of cases and control so that the findings are utilized in designing plan to reduce stunting, to develop prevention strategies and strengthen nutrition interventions.

2. Objective

The objective of this study was to identify determinants of stunting among children aged less than 5 years old based on the 2011EDHS data.

3. Methods and Materials

3.1.Study Design and Period

Unmatched case control design was employed from January to June 2015 by using data obtained from the 2011 EDHS.

3.2.Study Area

Ethiopia has an area 1.1 million square km with population of 87,952,000 which is the major constituent of the landmass known as the Horn of Africa and it is a country in which children in age group 0-4 years shares the highest proportion in the population (15%) (35).It is one of the fourteen countries which are the home to 80 per cent of the world's stunted children(1, 11). In Ethiopia, 40 percent of children under age five are stunted, and 19 percent of children are severely stunted. There are nine regional states and two city administrations with regional variation in the prevalence of stunting in children. Stunting levels are above the national average in Tigray and Affar (46 percent each), SNNP (44 percent) and Amhara (42 percent), and relatively low in Gambela and Addis Ababa (22 and 23 percent, respectively) (11).

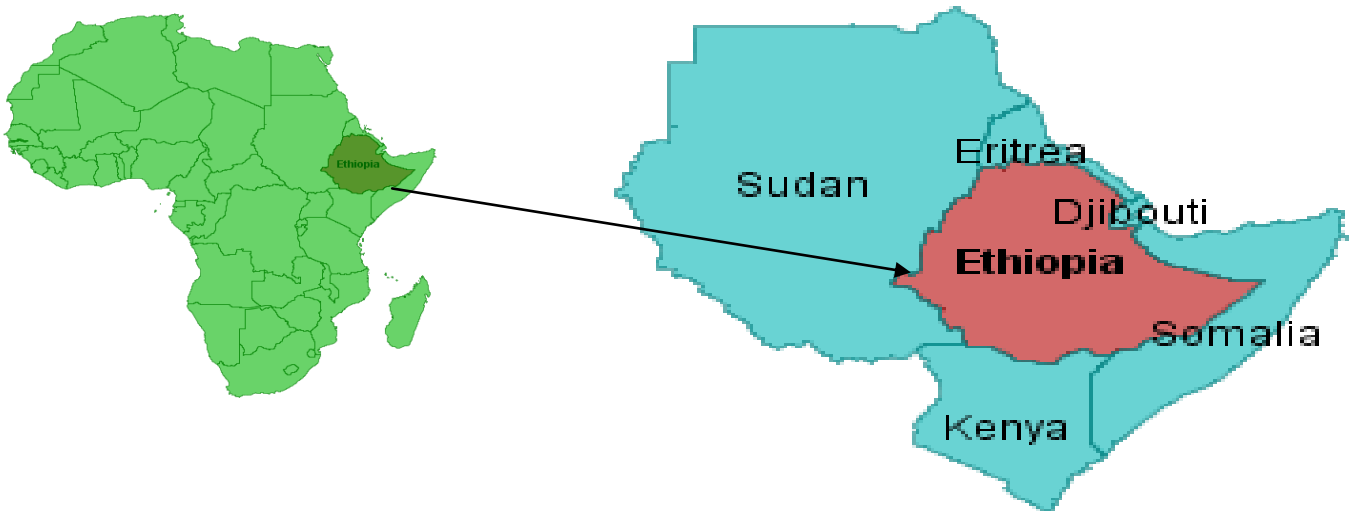

Figure 2: A map showing the study area and its surroundings

3.3. Source and Study populations

***3.3.1. Source population*:** All children with age range from 0 to 59 month of the citizen of Ethiopia.

***3.3.2. Study population*:** Under five children who were the residence of the randomly selected cluster in the 2011 EDHS.

Cases: Cases were stunted children aged 0 to 59 month's HAZ below -2SD from the median height of the WHO reference population during EDHS2011 data collection period.

Controls: were children aged 0 to 59 months not stunted by the EDHS2011 measurement.

3.4.Sample Size determination

A total of 11,152 children under age five were eligible for weight and height measurement. Analysis and presentation were done for 9,888 of these children. 4233 cases and 5655 controls with no missing value for age and with complete measurement of height were identified by the measurement of HAZ-score and included in study.

3.5. Sampling procedure

The 2011 EDHS used a two-stage stratified-cluster sampling based on the 2007 National Population and Housing Census. This survey has selected 624 Census Enumeration Areas(CEAs) (187 urban and 437 rural) which resulted in representative sample of 17,817 households selected which in turn drawn a total of 11,152 eligible children under age five(8).A total of 9,888 under five children with completed measurements of height and no missed values of age were included in the study. From the 9,888 children, 4,233 cases and 5,655 controls were identified. Figure 3 shows the details of the procedures.

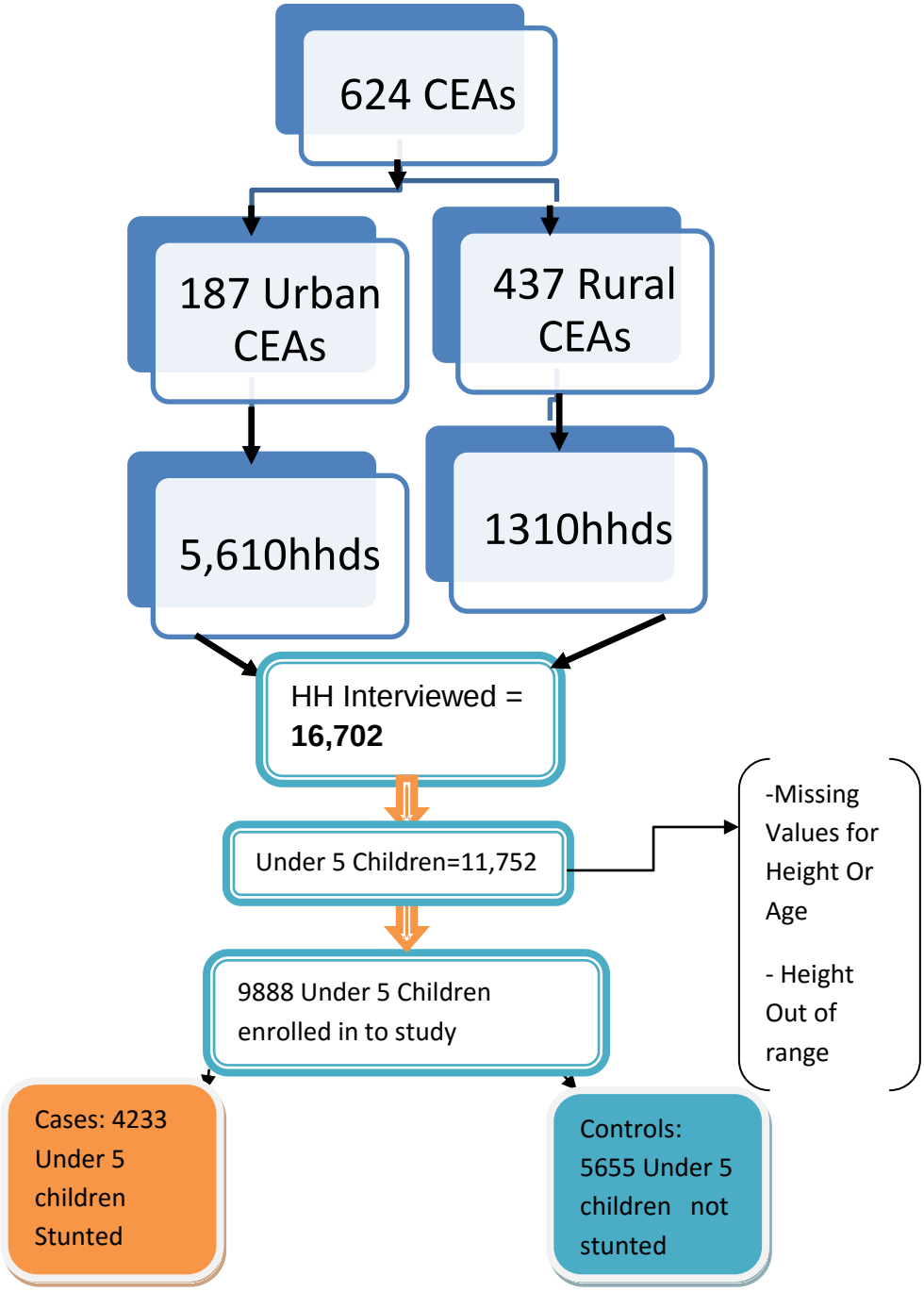

Figure 3: Sampling procedure and exclusions to identify the final sample size

3.6.Study variables

3.6.1 Dependent Variable:

Stunting (stunted, non stunted)

3.6.2 Independent variables

3.6.2.1 Child characteristics

Age of the child, sex of the child, presence of ARI, diarrhea and fever in 2 weeks before the survey, perceived child size by the mother, birth order of the child, preceding birth interval, vaccination status and anemia status.

3.6.2.2 Parental characteristics

Age of mother at giving birth, marital status of the mother, maternal occupation, maternal education, place of delivery, types of assistance during delivery, partner education status, partner education, partner occupation, partner support with household chores, decision making power of the mother and nipple using to feed the child.

3.6.2.3 Household characteristics

Household wealth index, source of drinking water, availability of toilet facility, family size of the household and number of under 5 children in the household.

3.6.2.4 Community characteristics

Region, residence, and religion

3.7 Operational Definitions

Stunted: Too short relative to their age children whose HAZ-score is below negative two SD from the median of the WHO reference population.

Not stunted: Children who's HAZ-score are ≥ 2SD from the median of the WHO reference population.

Improved toilet facility: Those households that use pour flush toilets; ventilated improved pit (VIP) latrine and latrine with slab were considered to have toilet facilities.

Unimproved toilet facility: Those households that use pit latrine without slab, composting toilet, bucket toilet, hanging latrine, and bush or field were considered as households who don't have toilet facility.

Protected drinking water source: are drinking water types including piped into dwelling/yard/plot, public tap, protected well/spring, borehole, and bottled water

Unprotected drinking water source: surface water (river/ponds/stream/dam), tanker truck, unprotected well/spring, and rain water.

Decision making power of mother: Decisions on how the money earned by the mother and/or the husband's/partner's are used, decisions about health care visit, decisions about making about the major household purchases, decisions about visits to own family or relatives

Perceived child size by the mother: It was measured either by the response and reflection of the mother about the size of the child at birth or by the record at birth if available. The child weight at birth was categorized to two categories as less than 2.5kg if the mother's response was 'small' or the record was less than 2.5kg at birth and it was greater than 2.5kg or if the mother's response was 'big' and the record was greater than 2.5kg during delivery.

Presence of Acute Respiratory Infection: Is defined as having symptoms of cough accompanied by short, rapid breathing which was chest related during two weeks preceding the survey.

Presence of diarrhea: Any child with watery or bloody and mucus stool in two weeks preceding the survey was considered as having diarrhea.

Presence of fever: Illness of a child with fever at any time in two weeks preceding the survey

Wealth Index: is a measure that used to indicate inequalities in household characteristics, in the use of health and other services, and in health outcomes constructed using household asset data via a principal components analysis.

Living with partner: Marriage without traditional or legal agreement

Narrow preceding Birth Interval: The gap of twenty four and less months before the birth of child included in the study.

Moderate Preceding Birth Interval: Children with duration of 24 to 48 months birth before the birth of the study subjects.

Wide Preceding Birth Interval: The gap above four years between the children included in the study and children born prior to them.

Birth order: Children born first to three were considered as early born, four to six were considered as middle born and those born in the order of above six were considered as late born to their respective mothers.

Age of household head: The age representative of the household ranges from 18 to 29 were considered as young age, 30 to 40 were categorized as adolescent age, and 41 to 49 were grouped as over aged headed households.

Nipple Using: Feeding of the child from bottle or nipple the last day or night of the interview day of the mother of the respected mother.

3.8 Data Source

Data collected by CSA and other stakeholders, and processed and organized by ICF International in to different datasets were accessed and downloaded from MEASUREDHS website. Dataset of children under five with interviewed women was selected and extraction of relevant variables and recoding of the data was done on.

3.9 Data Processing and Analysis

The dataset accessed was coded and checked for completeness and analyzed by using SPSS version 20. Changing of the values of the height of children from millimeter to centimeter unit was made. Moreover, calculation of the HAZ score was done by using the Emergency Nutrition Assessment/ENA software. The values of HAZ calculated by ENA software were exported to Excel and then transferred to SPSS for the final analysis. Descriptive analysis was performed and presented by using tables and graphs. Binary and multivariable logistic regression analyses were employed.

The variables which have a statistical significance association in the final multivariable analysis were identified on the basis of p-values < 0.05 and AOR with 95% confidence intervals at the end.

4. Ethical Considerations

The EDHS surveys were approved by the government of Ethiopia and by ICF International Review Board in Calverton, Maryland, USA. The EDHS obtained written consent from the respondents; mothers provided consent of their children to give the information. Height and length measurements and weighting of children were done by obtaining written consent for each activity. For analysis, the PI received permission from ICF International online for the use of available dataset. Confidentiality was maintained by not passing the dataset on to other researchers without the written consent of DHS. To make the dataset more secured, the downloaded dataset was kept separately from other files and protected by password of the PI. Approval and obtaining ethical clearance from the University of Gondar, Institute of Public Health Review Board was secured.

5. Results

5.1 Background Characteristics of the study participants

A total of 9888 children with complete measurement of height and full information of age of which 4,233 stunted, and 5,655 not stunted were included in the study. Out of 4233 stunted children, 90.0% of them were rural residents while 79.6% of the non stunted children included were rural resident of Ethiopia during the data collection period of EDHS2011. From 9888 participants included in the analysis, 84.1% were from rural and 15.9% were from urban. The majority of participants' mothers, 1971(46.6%) of cases and 2592(45.8%) of controls, were Muslim by religion. Stunting of under five children was highly prevalent (52.4%) in Afar region, followed by Amhara (51.9%) and Tigray regions (51.6%) respectively (Figure 4)

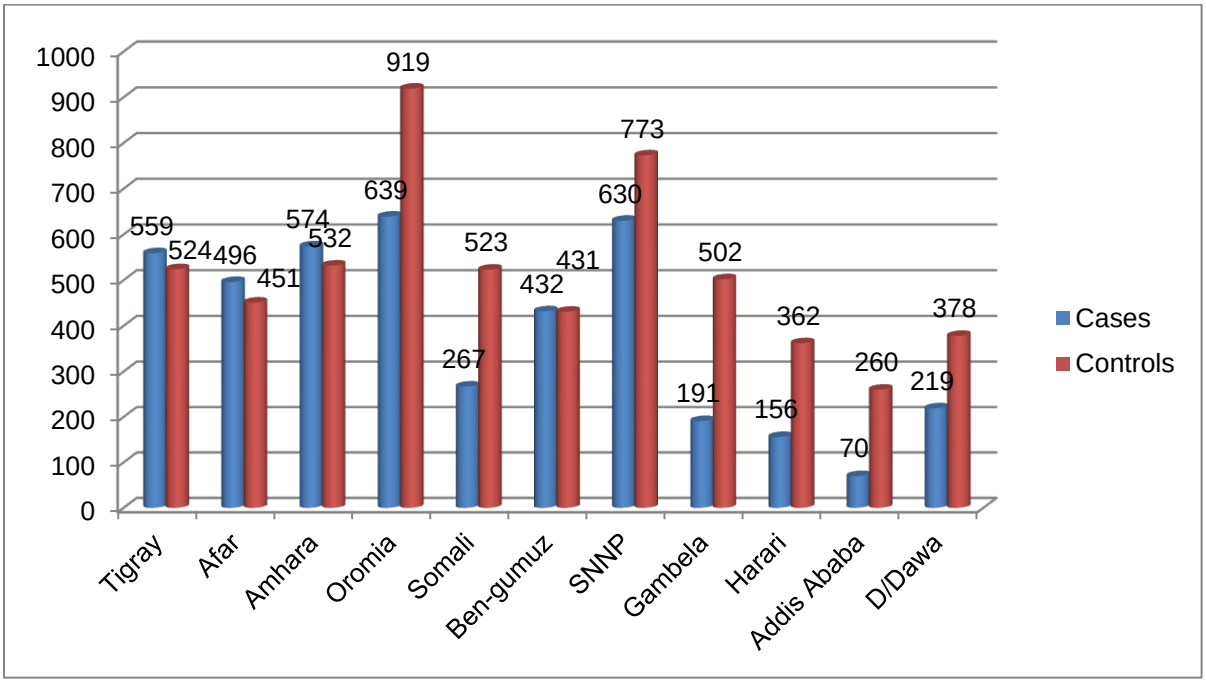

Figure 4: Stunted and not-stunted numbers of children included in the study across regions

From all the stunted children, 61.5% of the households used unprotected water sources for drinking. In similar ways, 92.3% of the cases were from those who have no toilet facility or users of unimproved types of toilets and the majority were from the poorest households. Most of the participants, 65.5% and 66.4% of the stunted and not stunted children were from households with family size ranges from 5 to 9 respectively and 48.0% of the cases and 46.5% of the controls included were from households with two under five children respectively.

The age group 25-29 years old mothers shared the highest number of both stunted and not stunted children. Regarding parental education, the majority of respondent and the partner are uneducated parents in either of the group. For instance, 75.8% of the mother of stunted children didn't attend any level of formal education while the figure was 65.6% for mothers of controls. Agriculture was the leading occupation type of mothers (51.7% cases and 42.8% of controls) as well as husbands' (79.0% of cases and 69.0% of controls).

Males were slightly higher than the females among the cases, 53.3% and 46.7% respectively, whereas the male and female percentage was almost similar (49.2% males and 50.8% females in the control group). The numbers of any kinds of twins were negligible as the 96.9% of stunted and 98.2% of the controls study subjects were single births. More than half of the children in both cases and controls were characterized with moderate preceding birth interval. On the other hands, nearly half of the cases and controls were in the early birth order groups. Despite the promotion of institutional delivery, 92.2% of the stunted children and 83.6% of the control children born 5 years preceding the survey were not born at health institutions. Almost all deliveries were not by cesarean section (98.7% in cases and 97.0% in control groups. The percentages in any levels of anemic children were higher in stunted group than those in the counterpart. (Table 1)

Table 1: Household and Community related characteristics of stunted and not stunted children aged 0–59 months by EDHS 2011(n_1=4233, n_2=5655)

Variables		Stunting	
		Cases (%)	Controls (%)
Residence	Urban	422(10.0)	1154 (20.4)
	Rural	3811(90.0)	4501 (79.6)
Source of drinking water	Unprotected source	2588 (61.5)	3022 (53.9)
	Protected source	1619 (38.5)	2589 (46.1)
Types of toilet facility	Unimproved	3907 (92.3)	4779 (84.5)
	Improved	326 (7.7)	874 (15.5)
Number of household members	1-4	1082 (25.6)	1487 (26.3)
	5-9	3753 (65.5)	2773 (66.4)
	≥10	415(8.9)	378 (7.3)
No of under 5 children in the HH	1	1439 (34.0)	1857 (32.8)
	2	2033 (48.0)	2629 (46.5)
	≥3	761 (18.0)	1169 (20.7)
House hold wealth index	Poorest	1451 (34.3)	1628 (28.8)
	Poorer	891 (21.0)	932(16.5)
	Middle	721 (17.0)	915 (16.2)
	Richer	709(16.7)	913 (16.1)
	Richest	461 (10.9)	1267 (22.4)

Table 2: Parental related characteristics of cases and controls children aged 0–59 months by EDHS 2011

Variables		Stunting	
		Case (%)	Control (%)
Age of Mother	15-24	935(22.1)	1418(25.1)
	25-29	1294(30.6)	1815(32.1)
	30-34	922(21.8)	1126(19.9)
	35-49	1082(25.6)	1296(22.9)
Education Level of Mother	No Education	3710(75.8)	3210(65.6)
	At least primary school	1945(24.2)	1023(34.4)
Marital Status of Mother	Married	3745(88.5)	4976(80.0)
	Living with Partner	172(4.1)	312(5.5)
	Widowed	83(2.0)	94(1.7)
	Divorced	154(3.6)	146(2.6)
	Separated	60(1.4)	93(1.6)
	Never in Union	19(0.4)	34(0.6)
Husband Education Level	No Education	2464(58.5)	2717(48.45)
	Primary	1504(35.7)	2100(37.4)
	Secondary	160(3.8)	486(8.7)
	Higher	83(2.0)	308(5.5)
Husband Occupation	No Work	68(1.6)	132(2.4)
	Manual Work	210(5.0)	462(8.3)
	Clerical/Sales/Services	470(11.2)	820(14.7)
	Agricultural	3300(79.0)	3846(69.0)
	Professional/Technical/Managerial	131(3.1)	313(5.6)
Mothers Occupation	No Work	323(16.1)	388(16.0)
	Agricultural	1035(51.7)	1040(42.8)
	Professionals and clericals	645(32.2)	1001(41.2)
Age of Household Head	Young	38(22.2)	1378(24.4)
	Adolescent	3143(74.2)	4087(72.3)
	Over Age	152(3.6)	190(3.4)
Type of Earnings by mother	Not Paid	560(27.3)	526(21.2)
	Cash only	698(34.1)	1040(41.9)
	Cash and Kind	597(29.2)	702(28.3)
	In-kind only	193(9.4)	212(8.5)

Table 3: Child related characteristics of cases and controls children aged 0–59 months by EDHS 2011

Variables		Stunting	
		Case (%)	Control (%)
Child Sex	Male	2257(53.3)	2783(49.2)
	Female	1976(46.7)	2872(50.8)
Child Age in Months	≤ 6	171(4.0)	1122(19.8)
	6-11	178(4.2)	611(10.8)
	12-23	796(18.8)	1015(17.9)
	24-35	1045(24.7)	892(15.8)
	36-47	1116(26.4)	971(17.2)
	48-59	927(21.9)	1044(18.5)
Types of Birth	Singleton	4100(96.9)	5552(98.2)
	Pair	53(1.3)	52(0.9)
	Triple and more	79(1.9)	51(0.9)
Preceding Birth Interval	Narrow Preceding BI	937(26.8)	972(21.5)
	Moderate Preceding BI	1964(56.2)	2486(55.9)
	Wide Preceding BI	569(17.0)	1060(23.5)
Birth Order	Early Born	2018(47.7)	3009(53.2)
	Middle Born	1476(34.8)	1692(29.9)
	Late Born	739(17.5)	954(16.9)
Nipple Using	No	3882(93.4)	4923(88.0)
	Yes	274(6.6)	673(12.0)
Anemia Level of the Child	Sever	191(4.8)	115(2.5)
	Moderate	1059(26.7)	1060(23.4)
	Mild	880(22.2)	957(21.2)
	Not Anemic	1833(46.3)	2392(52.9)
Breast Feeding conditions	Ever, Not current	2511(59.6)	2698(47.8)
	Never Breast Feeding	56(1.3)	91(1.6)
	Still Breast Feeding	1647(39.1)	2852(50.6)
Place of Delivery	Home and Other Sectors	3899(92.2)	4726(83.6)
	Health Facilities Delivery	331(7.8)	926(16.4)
Delivery by CS	No	4178(98.7)	5485(97.0)
	Yes	55(1.3)	170(3.0)
Size of the Child at Birth	Very Large	626(14.8)	1023(18.1)
	Larger than Average	469(39.8)	708(12.5)
	Average	1678(39.7)	2233(57.1)
	Smaller than Average	386(9.1)	499(8.8)
	Too small	1071(23.3)	1184(21.0)
Ever Had Vaccination	No	796(23.9)	1302(31.6)
	Yes	2532(76.1)	2823(68.4)

5.2 Determinant factors of stunting

Child and parental conditions, household and community related determinants in relation to stunting were analyzed using bi-variable logistic regression and all explanatory variables with p-value less than 0.05 in bi variable analysis were entered to multiple variable analysis of binary logistic regression after assumptions of binary logistic regression was checked.

In bi-variable logistic regression analyses, 33 variables which were assumed to be associated with stunting were analyzed by the enter method of binary logistic regression and variables with p-value less than 0.05 significance level were entered into the multiple logistic regression. Twenty seven (27) of the 33 explanatory variables (residence kinds, types of drinking water sources, a kind of toilet facility the household use, family size of the household, number of children less than 5 years, wealth index; age, education level, marital status, occupation and type of earnings of the mother; husband occupation and education level, age of household head, child's sex and age, types of birth, preceding birth interval, birth order, anemia status of the child, breast feeding condition of the child, place of delivery, caesarean section delivery, size of the child at birth, 24 hours recall of nipple using conditions and receiving vaccination or not) were statistically significantly associated with stunting at p-value less than 0.05 and considered for further analysis in multivariate logistic regression.

Despite the surplus explanatory variables found significant in bi-viriate analysis, only six of them were identified as the determinants of stunting of under five children in Ethiopia. The explanatory variables associated with dependent variables with p-value less than 0.05 at 95%CI were number of children less than 5 years, household wealth index, husband education level, age of the child, preceding birth interval and anemia status of the child. The rest variables were not significantly associated in multivariate analysis and excluded and hence failed to be interpreted.

Accordingly, children in the respective age groups of 12-23, 24-35,36-47 and 48-59 were(AOR=3.523, 95%CI=1.382, 8.981), (AOR=5.526, 95%=2.172,14.060),

(AOR=4.178, 95%CI=1.640,10.607) and (AOR=3.841, 95%CI=1.510,9.77) times more likely to be stunted as compared to the children aged six months and less. Children with narrow (≤24 months) and moderate preceding birth interval (25-48 months) were (AOR=1.881, 95%CI=1.414, 2.503) and (AOR=1.704, 95%CI=1.341, 2.164) times more likely to be stunted as compared to those with wide (≥49 months) preceding birth interval respectively. Anemic children were (AOR=1.304, 95%CI=1.197, 1.420) times more likely to be stunted than those of the not anemic children.

Regarding parental characteristics, children whose father didn't attend any formal education (AOR=2.042, 95%CI=1.022, 4.080) times more likely to be stunted compared to those children whose father attended higher institutions.

Those children from households with two under five children (AOR=1.846 95%CI=1.393, 2.446) times and with three or more than three under five children (AOR=1.458, 95%CI=1.410, 1.864) times more likely to be stunted as compared to those children in the household with single under five children.

Children aged 0–59 months from the poorest households (AOR =1.880, 95%CI=1.348, 2.621), the poorer households (AOR=2.042, 95%CI=1.445, 2.885), middle income households (AOR = 1.440, 95%CI=1.020, 2.032), and richer households (AOR = 1.699, 95%CI=1.203, 2.399) were more likely to be stunted compared with those from richest households.

Table 4: Biviriate and multivariate determinants association with stunting among under five children, 2011Ehhiopian Demographic Health survey, May 2015

Explanatory Variables	Frequency		COR[95% CI]	AOR[95% CI]
	Cases	Controls		
Place of Residence				
Urban	422	1154	1	
Rural	3811	4501	2.315(2.054,2.609)**	
Drinking Water sources				
Unprotected sources	2588	3022	1.369(1.263,1.485)**	
Protected Sources	1619	2589	1	
Toilet Facility Types				
Unimproved	3907	4779	2.192(1.917,2.506)**	
Improved	326	874	1	
No of Household Members				
1-4	1082	1487	1	
5-9	3753	2773	1.015(.926,1.114)	
≥10	415	378	1.252(1.067,1.469)*	
# of under 5 children in HH				
1	1439	1857	1	
2	2033	2629	1.190(1.062,1.335)*	1.846(1.393,2.446)**
≥3	761	1169	1.188(1.066,1323)*	1.458(1.410,1.864)*
Household Wealth Index				
Poorest	1451	1628	2.450(2.155,2.784)**	1.880(1.348,2.621)**
Poorer	891	932	2.627(2.283,3.024)**	2.042(1.445,2.885)**
Middle	721	915	2.166(1.874,2.502)**	1.440(1.020,2.032)*
Richer	709	913	2.134(1.846,2.467)**	1.699(1.203,2.399)*
Richest	461	1267	1	
Age of Mother				
15-24	935	1418	1	
25-29	1294	1815	1.081(.969,1.206)	
30-34	922	1126	1.242(1.101,1.400)**	
35-49	1082	1296	1.266(1.128,1.421)**	
Education Level of Mother				
Not Educated	3710	3210	1.645(1.505,1.799)**	
At least Primary attendants	1945	1023	1	

Table 4: Bivariate and multivariate determinant association of stunting (Continued…)

Explanatory Variables	Frequency		COR[95% CI]	AOR[95% CI]
	Cases	Controls		
Marital Status of Mother				
Married	3745	4976	1	
Living with Partner	172	312	.732(.605,.887)*	
Widowed	83	94	1.173(.871,1.581)	
Divorced	154	146	1.402(1.113,1.765)*	
Separated	60	93	.857(.618,1.189)	
Never in Union	19	34	.743(.423,1.304)	
Husband Education Level				
No Education	2464	2717	3.365(2.625,4.314)**	2.042(1.022,4.080)*
Primary	1504	2100	2.658(2.067,3.417)**	
Secondary	160	486	1.222(.904,1.651)	
Higher	83	308	1	
Husband Occupation				
No Work	68	132	1.231(.862,1.758)	
Manual Work	210	462	1.086(.836,1410)	
Clerical/Sales/Services	470	820	1.369(1.084,1.729)*	
Agricultural	3300	3846	2.050(1.663,2.527)**	
Professional and Managerial	131	313	1	
Mothers Occupation				
No Work	323	388	1.292(1.082,1.543)*	
Agricultural	1035	1040	1.544(1.355,1.761)**	
Professionals and clericals	645	1001	1	
Age of Household Head				
Young	938	1378	1	
Adolescent	3143	4087	1.130(1.027,1.242)*	
Over Age	152	190	1.175(.935,1.477)	

Table 4: Bivariate and multivariate determinant association of stunting (Continued…)

Explanatory Variables	Frequency		COR[95% CI]	AOR[95% CI]
	Cases	Controls		
Type of Earnings by mother				
Not Paid	560	526	1.169(.931,1.470)	
Cash only	698	1040	.737(.593,.916)*	
Cash and Kind	597	702	.934(.747,1.168)	
In-kind only	193	212	1	
Child Sex				
Male	2257	2783	1.179(1.088,1.277)**	
Female	1976	2872	1	
Child Age in Months				
≤ 6	171	1122	1	
6-11	178	611	1.912(1.516,2.410)**	
12-23	796	1015	5.146(4.273,6.196)**	3.523(1.382,8.981)*
24-35	1045	892	7.687(6.395,9.240)**	5.526(2.172,14.060)**
36-47	1116	971	7.541(6.284,9.051)	4.178(1.646,10.607)*
48-59	927	1044	5.826(4.849,7.000)	3.841(1.510,9.770)*
Types of Birth				
Singleton	4100	5552	1	
Pair	53	52	1.380(.939,2.028)	
Triple and more	79	51	2.098(1.472,2.990)**	
Preceding Birth Interval				
Narrow Preceding BI	937	972	1.714(1.499,1.962)**	1.881(1.414,2.503)**
Moderate Preceding BI	1964	2486	1.405(1.251,1.579)**	1.704(1.341,2.164)**
Wide Preceding BI	569	1060	1	
Birth Order				
Early Born	2018	3009	1	
Middle Born	1476	1692	1.301(1.189,1.423)**	
Late Born	739	954	1.155(1.033,1.291)*	
Nipple Using				
No	3882	4923	1	
Yes	274	673	1.937(1.673,2.243)**	

Table 4: Bivariate and multivariate determinant association of stunting (Continued…)

Explanatory Variables	Frequency		COR[95% CI]	AOR[95% CI]
Anemia Level of the Child				
Not Anemic	1833	2392	1.304(1.197,1.420)**	1.466(1.225,1.754)**
Anemic	2130	2132	1	
Breast Feeding conditions				
Ever, Not current	2511	2698	1.612(1.486,1.748)**	
Never Breast Feeding	56	91	1.066(.760,1.495)	
Still Breast Feeding	1647	2852	1	
Place of Delivery				
Home and Other Sectors	3899	4726	2.308(2.022,2.635)**	
Health Facilities Delivery	331	926	1	
Delivery by CS				
No	4178	5485	2.354(1.733,3.199)**	
Yes	55	170	1	
Size the Child at Birth				
Very Large	626	1023	1	
Larger than Average	469	708	1.083(.929,1.262)	
Average	1678	2233	1.228(1.091,1.382)*	
Smaller than Average	386	499	1.264(1.071,1.492)*	
Too small	1071	1184	1.478(1.299,1.682)**	
Ever Had Vaccination				
No	796	1302	.682(.615,.756)**	
Yes	2532	2823	1	

* Significant at p-value < 0.05 *significant at p-value < 0.05 in bivariate
** Significant at p-value < 0.01 **significant at p-value < 0.001 in bivariate
Note: - Hosmer and Lemeshow's goodness of fit model test was found to be chi-square of 5.839 with p-value of 0.665 favoring the null hypothesis that the model is appropriate.

6. Discussion

This study presents the determinants of stunting among children of age 0–59 months using the 2011 EDHS data. Six major determinants were identified by the multi variable backward method of binary logistic regression.

Despite many interventions implemented to reduce the percentage of stunting among under-five children in Ethiopia, the prevalence remains consistently high (8) .This explains the fact that there are other underlying factors, like household wealth index for example, which contributes to the high rate of stunting among children aged less than five.

This study indicated that the odds of children being stunted in the age group 24 to 35 were 5.5 times higher than the odds of those who were six months and less of age. Similarly, children in the age groups 12-23, 36-47 and 48-59 were 3.5, 4.178, and 3.8 times at high risk of being stunted than the children six month and under respectively. Similar results have been found in Cambodia by the analysis of pooled data from three DHSs, Nepal DHS and Ethiopia (8, 13, 14). But the child charecteristics age was insignificant in the study conducted in the Eastern rural Ethiopia (7).The pick odds ratio of being stunted observed among children 24-35 months may be associated with poor feeding conditions by the parents when the children totally cease breast feeding, prolonging duration of breast feeding and less care of the child due to new pregnancy or child.

When we investigate about preceding birth interval, the odds of being stunted among children born with narrow and moderate preceding birth interval were 1.88 and 1.70 times higher than the odds of those with wide preceding birth interval and this finding aligned with the research conducted in Nigeria and Cambodia (19*,* 31). However, preceding birth interval was not statistically associated with under five stunting in similar study conducted in Nepal, rather the perceived weight of the child at birth was statistically associated with stunting which was unlikely of the findings of this study (25). The possible reasons are poor care of the children by the parents as of too many

children in narrow births and overcrowded of under five children may lead to improper feeding conditions and unequal sharing of food among them. Another explanation is related to maternal nutrition and health care conditions. The mother may be affected by immediate and repeated kinds of pregnancy and this is ultimately resulted in child stunting.

This study also revealed that anemic children are more at risk of being stunted by 30.4% than those of the not anemic children. A lancet report witnessed that anemia which is caused by iron deficiency has significant effect on child growth and cognition (4, 5). From the study in Central India, children having anemia had 1.9 times higher odds of being stunted than children who were not anemic (22) while it was not differ significantly by immunization status. These two findings are similar in both anemia status and immunization conditions.

Anemia is not a disease, but rather the expression of an underlying disorder or disease usually associated with decreased levels of hemoglobin and a decreased packed cell volume (hematocrit), and/or a decreased RBC count. Nutritional deficiencies, external or internal blood loss, increased destruction of RBCs and ineffective or decreased productions of RBCs are among the various disease and disorders associated with decreased hemoglobin levels.

Children belongs to those fathers who didn't attend any formal education were twice more at risk of being stunted than children whose fathers' attended higher institutions. This finding is inconsistent with other findings conducted in Ethiopia and Uganda (28, 30). The possible difference may be due to the scope of the study in that this finding used the national data where as the specified researches were limited to some narrow geographical areas.

Those children from households with two under five children were 1.84 times more at risk and households with three or more than three under five children were 1.458 times more at risk of being stunted compared to those children in the household with a single under five children respectively. This is consistent with findings of the study of SNNP of

Ethiopia (28) On another hands, children whose mothers had 5–8 children were more likely to be stunted compared to those whose mothers had 1–4 children from the findings in Ghana (32).

The other important household related determinant identified by this study is the household wealth index. Accordingly, under five children from the poorest households were 1.9 times more at risk of being stunted than the children from the richest households. In similar fashion, children from the poorer, middle income and richer households were about twice, 1.5times, and 1.7times more at risk of being stunted than those under five children from richest households respectively. The findings of this study support those of other similar studies, which indicated that household wealth index is the underlying determinants of stunting (19).

When compared with children from the richest households, the odd ratio of children belongs to the poorer households is more than the children from the poorest households. Similarly, children in the richer level of households were at higher risk of being stunted than the children from the middle income households. This findings proved that being at higher income household is not a guarantee for not to be stunted. The possible reason for this to happen is improper use of resources like feedings, poor utilization of resources, poor child and maternal health care, poor sanitation and hygiene and so on despite the high score of the wealth index.

In contrast to many other studies, maternal education and occupation were insignificant in this study. Lack of statistically significant association between maternal education and occupation, and children's stunting might be attributed to the overall education and occupational status of the participants in that the majority of the mothers involved in the study didn't attend formal education and are jobless.

Strength and Limitation of the study

Strength of the study

The study design used was analytical, case control study design, which has better strength in detecting the association between stunting and many exposure variables.

The fact that large sample, all children with age less than five years with complete measurement of height and no missing value for age where included to the study is also strength of the study because this increases the power to detect the association between the dependent and the independent variables sufficiently.

The categorization of child in to cases and controls was done experimentally by the measurement of height of children and asking the age of children in months and this is less prone to misclassification bias because the quality of data collectors is up to the standard in measuring and in probing techniques employed to reach the correct age.

Limitation of the study

One limitation of this secondary data analysis was that, there was no information on dietary practices for children more than 2 years of age and this important variable is not considered in this study. Information on breast feeding is not sufficient in that first it doesn't show the lengths of months the child breast fed and secondly the questions was not asked for all under five children. Lack of information on exclusive breast feeding for all children less than 59 months was another drawback of this study. Generally, there many factors association with stunting but here not all factors were included in this study.

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7. Conclusions and Recommendations

7.1. Conclusions

In this study, household wealth especially the poorest and the poorer and number of under five children in the family were identified as the determinants of stunting from the household related variables. The husband or partner education status is also the only significant determinants identified from parental related characteristics. From the variables solely related to children; age, intervals of proceeding births and anemia status of the child were found statistically associated to stunting of under five children.

7.2. Recommendations

1. Government

There is a clear need of policy design to reduce economic inequalities which ultimately resulted in poverty reduction in the post MDG to reduce child stunting radically. The government should also continue in expanding adult education coverage to improve awareness in utilization of resources and improve child nutrition.

2. Non-governmental Organizations

Strengthen the multi sector interventions than focused in order to address interlinking determinants of stunting in particular and child malnutrition in general.

3. Federal Ministry of Health

The FMOH and other stakeholders working on reducing child stunting should include the main determinants identified by this study to their targets so that the prevalence is reduced to the target set by the government.

Strengthen the system of awareness creation on family planning, child feeding practices and micronutrient consumption.

Strengthen the system of service provision on child and maternal health care, family planning and micronutrients.

4. Health Care Workers/HCWs

The HCWs should aware the people about the importance of spacing between child births and also make the society to recognize the impact of crew of under five children in the family.

The HCWs should also increase awareness of the people towards micronutrients to reduce the prevalence of anemia as anemic children are more at risk of stunting than those of not anemic one.

Persistent service provisions on child and maternal health care, family planning and micronutrients.

5. Parents

Insure nutrition security by improving their knowledge and practice on proper use of resources, family planning, child feeding practices, uses of micronutrients, and maternal and child health care.

Implementations of recommendations given by HCWs are also crucial for the parents to improve the nutrition of children so that it contributes to the reduction of child stunting.

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9. Annexes

9.1.Annex1:Consent from MEASURE DHS

February 19, 2015

Teshome Kebeta

University of Gondar

Ethiopia

Phone: +251911453239

Email: tka1204@gmail.com

Dear Teshome:

You are authorized to use the Ethiopia Demographic and Health Survey datasets, for your research project titled: **"Determinants of Stunting Among Under-five Children".**

To download the DHS datasets, please login to your user account at:

http://www.measuredhs.com/data/dataset_admin/login_main.cfm.

The user name is your registered email address

The password is the one you selected during the registration process.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual

households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS datasets must not be passed on to other researchers without the written consent of DHS. You are requested to submit an electronic or hard copy of any reports/publications resulting from using the DHS data files to our office.

Sincerely,

Bridgette Wellington

Data Archivist

The Demographic and Health Surveys (DHS) Program

9.2.Annex 2: Data extraction tool from EDHS2011 dataset

Child Level Determinants	
Variables	**Categories/Definitions of Variables**
Case ID	
Child Sex	0=Female 1=Male
Age of Child	0= <6 months 1= 6-11 months 2= 12-23 months 3= 24-35 months 4= 36-47 months 5= 48-59 months
Presence of ARI in 2 weeks	0=No 1=yes
Presence of diarrhea in 2 weeks	0=No 1=yes
Presence of fever in 2 weeks	0=No 1=yes
Preceding birth interval	0=No previous birth 1=<12 months 2=12-24 months 3=>24months
Perceived child size by mother	0=Weight≥2.5Kg 1= Weight <2.5Kg
Birth Order of the child	0 = 1 1 = 2-3 2 = 4-5 3 = 6+
Anemia Status of the child	0=Not anemic

	1=Anemic
Vaccination Status of the child	0= child is taking vaccine 1=Completed 2=Not completed

Parental Determinants	
Variables	**Categories/ Definitions**
Line number of mother	
Line number of partner	
Age of mother at birth	<20 Years 20-24 Years 25-29 Years 30-34 Years ≥ 35 Years
Marital status of mother	0= Not Married 1=Married 2=Live-with partner 3=Divorced 4=Widowed
Maternal occupation	0=House wife 1=Farmer 2=Merchant 3=Government employee 4=Private employee 5= Self employee
Maternal education	0= No education 1= Primary education 2= Secondary 3= Technical/Vocational 4= Higher
Place of delivery	0= Health Facility 1= Home
Nipple using	0=User

	1=Not User
partner education	0= No education 1= Primary education 2= Secondary 3= Technical/Vocational 4= Higher
Partner occupation	0=Work less 1=Farmer 2=Merchant 3=Government employee 4=Private employee 5= Self employee
Partner support with household chores	0=Supporting 1=Not supporting
Decision Making of Mother	0=Decision maker 1= Not decision maker

Household characteristics	
Variables	Categories/ Definitions
Household ID	
Household Wealth Index	0= Poor 1= Medium 2= Rich
Source of drinking Water	0= Not improved source(surface water, tanker truck, unprotected well/spring, other's) 1= improved source(piped into dwelling, piped to yard/plot, public tap, protected well/spring, rain water, bottled water)

Possession of toilet facility	0= No facilities (bush/field toilet, hanging toilet, others) 1= Have facilities (Pit toilet, Flush/pour toilet)
Family size of the household	0=1-4 1=5-9 2= 10 and above
Number of Under 5 children in the household	0=1 1=2 2=3 and above
Stool disposal habit for under 5 children in the household	0= Left open 1= Disposed

Community Characteristics	
Variables	Categories/ Definitions
Residence	0= Rural 1= Urban
Religion of mother	1= Orthodox 2=Catholic 3=Protestant 4=Moslem 5=Traditional
Region	0= Tigray 1= Afar 2= Amhara 3= Oromia 4= Somali 5= Ben-gumuz

	6= SNNP 7= Gambela 8= Harari 9= Addis Ababa 10= Dire Dawa

9.3.Annex3: Declaration

I, the undersigned, senior MPH student declared that this thesis proposal is my original work in partial fulfillment of the requirement for the degree of Master of Public Health in Epidemiology and Biostatistics.

Name of the Investigator: Tashome Kebeta Dadi

Signature: _____

Place of submission: Institute of public Health, College of Medicine and Health Sciences, University of Gondar.

Date of Submission: _____

Advisors

1. Mr. Solemon Meseret (BSc, MPH) _____
2. Mr. Molla Mesele (BSc, MSc) _____